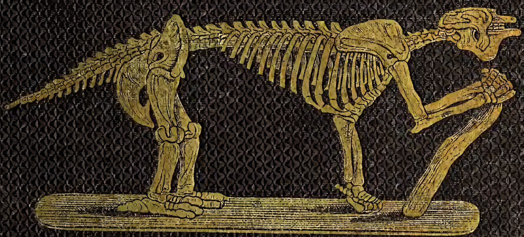
MEGATHERIUM CUVIERI



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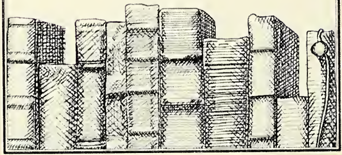

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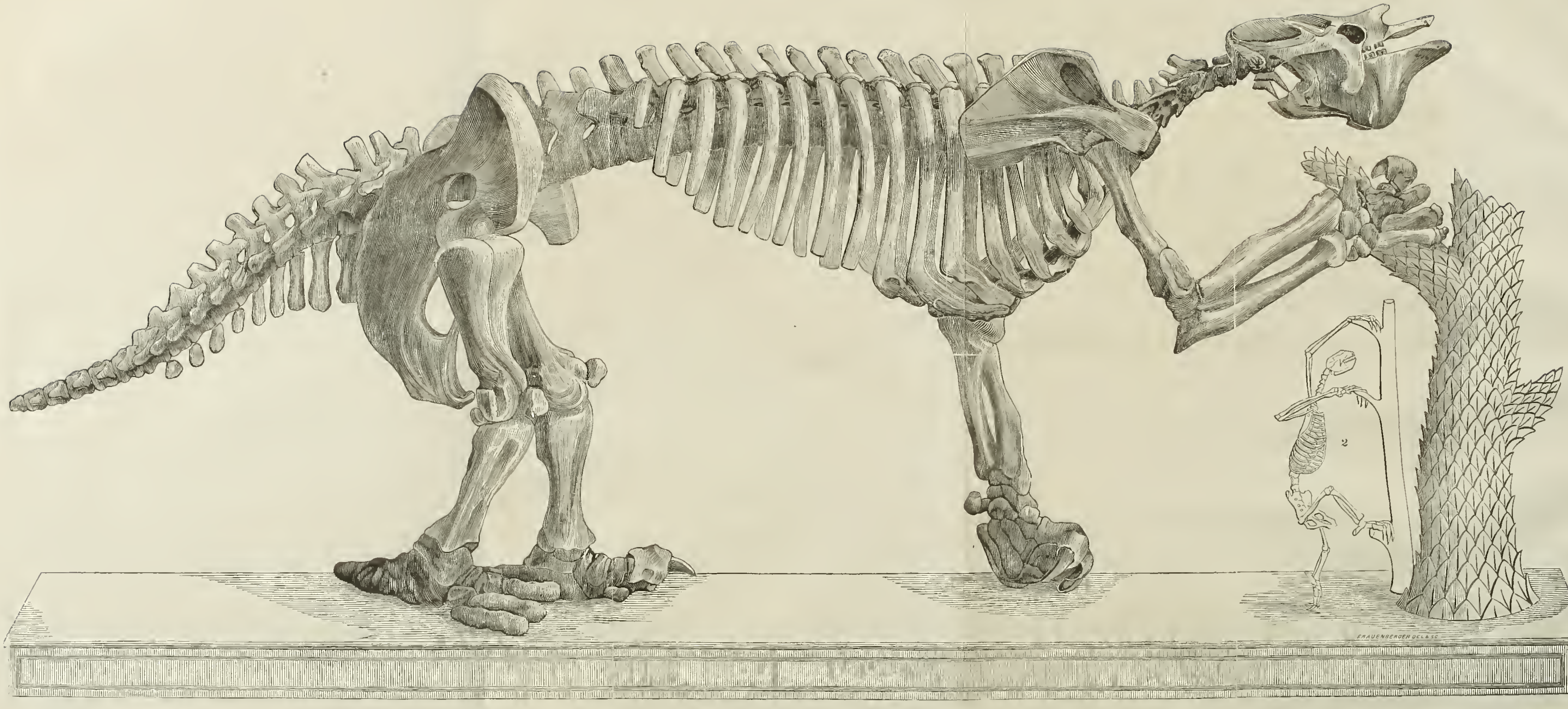
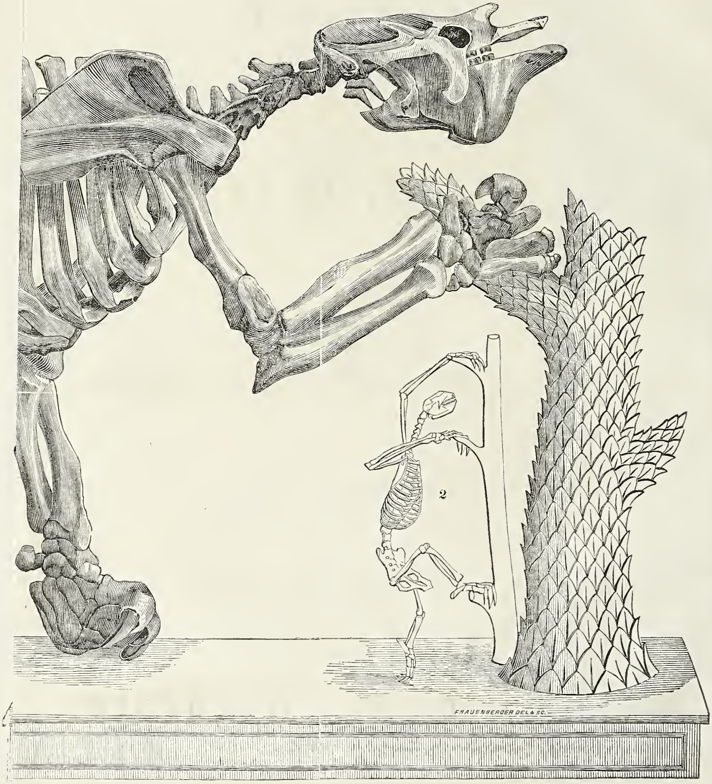


SKELETON OF MEGATHERIUM CUVIERI.

Fig. 2, Bradypus Tridactylus (Sloth).

Scale 1-14; *about one inch to the foot.*



UVIERI.

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NOTICE

OF THE

MEGATHERIUM CUVIERI,

THE

GIANT FOSSIL GROUND-SLOTH OF SOUTH AMERICA.

PRESENTED TO THE

University of Rochester,

BY

HIRAM SIBLEY, Esq.

"In Physiology, what is the meaning of that great law of adherence to type and pattern, standing behind, as it were, and in reserve, of that other law by which organic structures are specially adapted to special modes of life? What is the relation between these two laws; and can light be cast upon it derived from the history of extinct forms, or from the conditions to which we find that existing forms are subject?"

Duke of Argyle's Address as President of the British Association, 1855.

"The combination, in many extinct types, of characters which, in later ages, appear disconnected in different types, exhibits thought, prophetic thought, foresight; combinations of thought preceding their manifestations in living forms."

Agassiz' Essay on Classification in Contributions to the Natural History of the United States, Vol. I, p. 134.

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INTRODUCTORY.

The Geological Cabinet of the University of Rochester, already very rich in fossil organic remains, has lately received a most valuable addition of a copy in plaster of the *Megatherium Cuvieri*—the huge extinct Ground-Sloth from the Pampas of Brazil.

This unique specimen is the munificent gift of a prominent citizen of Rochester, Hiram Sibley, Esq., who, with enlightened liberality, furnished the funds expended in its purchase in London, its transfer to Rochester, and its permanent mounting in the largest of our Cabinet halls.

The several parts of the skeleton have been well and carefully put together — a tedious and absorbing task, which occupied the writer and two experienced assistants for a period of nearly two months.

The attitude given to the animal is of course hypothetical, but is intended to represent the manner in which, in all probability, it obtained its leafy food. It is in the act of wrenching from the trunk of a tree a low branch which it has seized with its powerful fore-arm. The gigantic size of the fossil its long arms with great terminal claws, its massive hind legs, its colossal tail, and its feet a full yard in length, are sure to strike every beholder with the profoundest wonder. One is tempted to doubt the reality of its former existence, and to think it some monstrous ideal fabric. Yet every bone in the entire skeleton is moulded over an actual specimen preserved in the cases of the British Museum and Royal College of Surgeons. Professor Owen, speaking of the same cast which was mounted at the British Museum under his direction, says, that it is "so beautifully exact, as, for all the essential purposes of science, to be of the same value and utility as the bones themselves would be if so articulated together." The wood cut which precedes the title page, gives a very correct view of the case as it appears in the centre of the hall. An iron-railing which surrounds the cast, presents upon its upright posts bronze figures of ten representative forms among the Edentates—the natural order to which the fossil belongs.

The object of the present memoir is to present in a concise form those facts in the history of the animal, its anatomical features, and its probable movements and habits, as are of the chiefest interest. Many of these facts are gathered from the memoir of Professor Owen upon the same fossil — one of the admirable series of monographs by which the great English naturalist has so extended the limits of knowledge in the departments of Zöology and Comparative Anatomy.

HENRY A. WARD.

Rochester, July, 1864.

NOTICE OF THE MEGATHERIUM.

§ 1. HISTORICAL INTRODUCTION.

On the water-worn banks of the river Luxan, near the city of Buenos Ayres, a skeleton of colossal proportions and strange anatomy was discovered in 1789. Having been carefully disinterred and transmitted to Madrid by the Governor, the Marquis of Loreto, it was there mounted by John Baptist Bru, and since that time has been the peculiar glory of the Royal Museum. Six years after, remains of the same animal were found in Peru and in Paraguay, and were also sent to Spain. In 1823 a part of the femur was found by a Prussian traveller, in Queguay in Uraguay, and sent to Berlin. In 1824 parts of the lower jaw, teeth, vertebræ, ribs, and leg-bones were obtained from the marshes of Skiddaway island on the coast of Georgia ; and soon after other fragments were collected on the shores of Ashley river in South Carolina. These specimens, with others since discovered in that region, are deposited in the Museums of the Lyceum of Natural History of New York, of the Academy of Natural Sciences of Philadelphia, and of the National Institute in Washington. In 1831, after a season of unusual drought, the river Salado, which flows through the flat alluvial plains south of Buenos Ayres, presented to the eye of a native a large shapeless mass standing out of the water. He supposed it to be the trunk of a tree. It was dragged out by means of lassoes, and taken to Don Hilario Sosa, the owner of the estate, who gave it to Sir Woodbine Parish. It proved to be the pelvis of the fossil first found at Luxan, and with many other bones, including parts not preserved in the Madrid specimen, was presented to the Royal College of Surgeons. To the same Museum were also sent some interesting remains discovered in 1834 by the eminent naturalist, Charles Darwin, at Bahia Blanca, in Northern Patagonia. In 1837 a skeleton, nearly entire, was discovered in the river Luxan, and deposited in the Museum at Monte Video; and various bones obtained the next year on the estate of Don Manuel Rosas, north of the Salado, are likewise preserved in that city. About the same time all the parts which were wanting in the collection of the Royal College of Surgeons were discovered near Luxan, and purchased by the trustees of the British Museum. It was from the originals in these two institutions that plaster-casts were taken ; and a complete skeleton, thus formed, was mounted in the British Museum, under the superintendence of Professor Owen. Other copies were liberally allowed by the Trustees and Council, one of which has recently been added to the Geological Museum of the University of Rochester.

Several years elapsed after the Madrid skeleton was mounted before its exact place in the animal kingdom was scientifically determined. Its gigantic size—in certain dimensions surpassing all known quadrupeds existing or extinct,—its singular composition of enormous pelvis and comparatively small head, a clavicle larger than that of any other animal, the structure of the fore-foot which brought the outer edge of the toes upon the ground in walking, and finally, the absence of a tail and pubis (which were accidentally wanting in the Madrid specimen); these all together presented a problem in comparative anatomy which the Savants of Europe found it difficult to solve. The discovery in the same Pampa deposit of a huge osseous armor or carapace* led astray the attention of investigators, and still further increased the difficulty of ascertaining its true relations. The Spanish naturalists spoke of it simply as "a quadruped very large and rare," not undertaking to assign it to any distinct order of animals. Abildgaard, a Danish Professor, referred it to the Edentates. Roume, of the French Institute, placed it intermediate, as to form, between the Cape Ant-eater and the Great Ant-eater of America. The great Cuvier, from an examination of drawings (for he never enjoyed the opportunity of seeing the skeleton itself), deduced its close affinity to the Sloth; and proposed the name of "MEGATHERIUM."† His conclusions as to the habits and food of the animal are summed up as follows. "Its teeth prove that it lived on vegetables, and its robust fore-feet armed with sharp claws, make us believe that it was principally their roots which it attacked. Its magnitude and its talons must have given it sufficient means of defence. It was not of swift course, nor was this requisite, the animal needing neither to pursue nor to escape." His views as to the exact nature of the fossil, particularly as to its food, were somewhat modified in later years, for he adds to a later edition of his famous work on FOSSIL REMAINS: "Its analogies approximate it to different genera of the Edentate family. It has the head and shoulder of a Sloth, while the legs and feet offer a singular mixture of characters peculiar to the Ant-eaters and Armadillos."

In 1821 Drs. Pander and Dalton, who had spent some time in a careful study of the specimen at Madrid, published a monograph on the Megatherium, in which they recognize its resemblance to the existing sloth, and to which, they say, it dwindled down by gradual degeneration. In their opinion, it was not merely an occasional digger of the soil, as Cuvier had last concluded, but altogether a creature of subterranean habits,—a sort of colossal mole.

The characters offered by the feet and claws seem to have had more weight for these naturalists than did different teachings of the other portions of the animal's structure. Cuvier had ventured to say that the carapace found alongside of the Megatherium possibly belonged to it, thereby making it a gigantic species of Armadillo.‡ This idea was afterwards advocated by Weiss, De Blainville, Grant, Clift and Buckland. De Blainville supported this view with the most determination, calling attention to the disposition of the spinous processes of the vertebræ, the angles of the ribs, the very remarkable flattening of the crest of the widely expanded ilia, and other modifications of the skeleton, which seemed adapted to the sustaining of this massive protecting shield. He sums up in favor of the opinion that the Megatherium had the habits and manners of the Armadillos, and consequently it fed upon flesh, and perhaps also upon roots; and that it was wont to dig the earth with its enormous claws, if not for concealment, at least for tearing open the nests of ants. Dr. Lund, of Copenhagen, was more bold than all others in his conjectures, and held unreservedly the opinion that the Megatherium climbed trees like Sloths at the present day,—the vegetation of that primeval age being on the same magnificent scale with the animal creation.

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* Since found by Owen to belong to a great fossil Armadillo, and described by him under the name of *Glyptodon clavipes.*

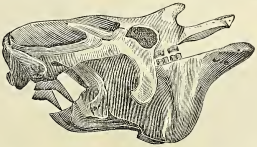
† From *μεγας great*, and *θηριον beast.*

‡ The osseous *tesseræ* of this carapace were proportionate with those in the shield of the living Armadillo; but none have ever been discovered of a size proportionate to an animal with the dimensions of the Megatherium.

The merit of clearing up the mist which hung over the nature and structure of this most remarkable of all fossil mammals, was reserved for Professor Owen, the accomplished English zoologist and comparative anatomist, the worthy successor of the peerless Cuvier· His "Memoir on the Megatherium," published in 1860, throws a flood of light on the habits and natural affinities of this singular quadruped. The following sketch, based upon that Memoir, will contain the main results of his investigation, together with such other points of interest as suggest themselves. He conclusively proves that the Megatherium was a ground Sloth, feeding on the foliage of trees, which it uprooted by its great strength; that it was not a burrower; and that it did not wear a bony armor.

§ 2. ANATOMICAL STRUCTURE.

The *Head* of the Megatherium presents the form of an elongated parallelogram, and is chiefly characterized by its small relative size, by the great depth of the lower jaw, and by the extraordinary size of the processes ascending and descending from the zygomatic arch.



The length of the skull is thirty-one inches; of the lower jaw, twenty-seven. Breadth across the widest part of the zygomatic arches, eighteen inches. In front, the palatine and maxillary portions descend considerably below the level of the rest of the skull, giving to the upper line of the head a very precipitate forward slope. The skull is unusually cellular, and the innermost stronger plate is covered with an outer table and intermediate walls to resist the violent shocks to which the animal was exposed. The brain-cavity within is thus far smaller than might be expected from the size of the skull.* The occipital condyles are very prominent, and their articular surface is so prolonged on all sides as to indicate great freedom of

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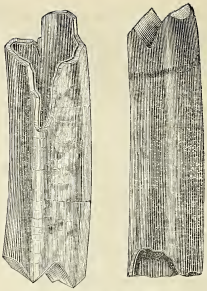
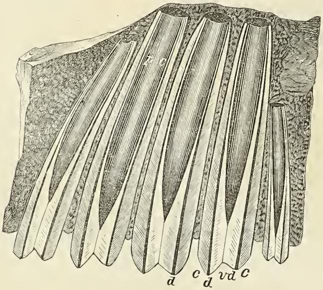
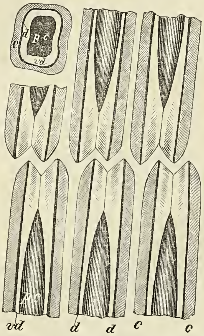
* The unfavorable idea of the animal's intelligence which is given by the very sloping head of the Megatherium, is not warranted by that fact alone. Here, as in many others of the mammals, the bony air-cells interposed between the outer and inner plates of the skull, quite mask the size of the brain-cavity. The most remarkable development of these cells in the Mammalian class is presented by the Elephant, as it is by the Owl among birds; the intellectual physiognomy of these animals being caused not by the actual capacity of the brain, but by the enormous extent of the cellular structure between the skull-walls.


Upper and Lower Molar Teeth : one third natural size.

motion of the head. The roof of the mouth is hollowed into a shallow furrow, forming, with a still deeper depression in the jaw below, a suitable chamber for a long, cylindrical and powerfully muscular tongue; while the sharp truncation of the muzzle, the deep excavation of its end, and the foramina for the passage of nerves and vessels seem to indicate the possession of a short proboscis. The lower jaw is of a very singular and extreme type, being nearly as great in vertical measure as in length. Much of this depth is due to a great downward expansion of the portion which bears the teeth, a modification necessitated by the very peculiar manner in which these latter are sustained in their growth. The depth of the jaw here is no less than nine inches and a half. The dental formula of the Megatherium is m. $\frac{5}{4}\,\frac{5}{4}=18$; the teeth being all molars, ten above and eight below. They are from 8 to 10 inches in length, and between 2 and 3 inches in breadth, presenting a long flattened prism with square corners, and slightly curved between their two ends. They are almost wholly buried in the jaw, with a single root of the same size and form as the crown. They repeat in their structure the dental peculiarities of the modern Sloth. A central axis of vaso-dentine is inclosed by a wall of unvascular dentine, and this by one of cement, and the teeth are so disposed in the two jaws that in the act of mastication, the hard dentine of one tooth came in contact with the softer part of its antagonist. So that a series of wedges or chisels, locking into each other, were perpetually formed and maintained by the simple wear of the teeth themselves. The nutritive fluid circulated through all their substance, and the growth and renewal of the whole took place in a large pulp-cavity at the base, which extended, with slightly diminished size, far up toward the crown of the tooth. This endowment



Section of Upper Molar Teeth.
vd. vascular dentine, *d.* unvascular dentine, *c.* cement,
pc. pulp-cavity.

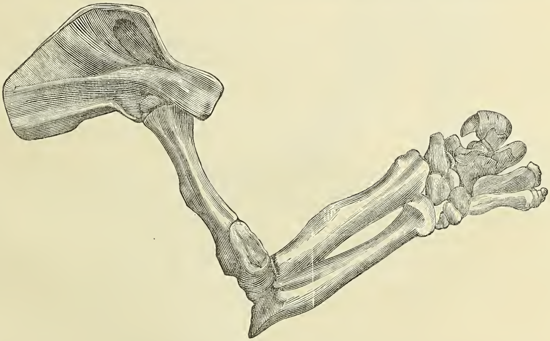


Section of Molars, showing the meeting of these in the upper and the lower jaw.

of a persistent formative capsule meets well the requirements of the dental apparatus of an animal whose life extended, as there is reason to believe, over more than a century.*

The *Spinal column* presents a character of great strength and firmness of articulations. It is composed of 7 cervical, 16 dorsal, 3 lumbar, 5 sacral, and 18 caudal vertebræ,—the entire length being 15½ feet. At the extremities the body of the vertebræ is round or oval; between the pelvis and neck it is trihedral. The sacral vertebræ are anchylosed to each other and to the pelvis, as in other quadruped Mammals. The neural canal is here a foot in circumference, and its very unusual size is sustained throughout the entire length of the column. There are sixteen pairs of ribs, of which eight articulate with the sternum, by means of completely ossified cartilages or hæmapophyses. The circumference of the skeleton at the eighth rib is ten feet, behind this the free ribs bend rapidly outward and upward, so that in the abdominal region their distal extremities are nearly as high as the crest of the iliac expansions of the pelvis.

The *Anterior Extremities* manifest all the main perfections of brachial structure to be seen in the Mammalian class. Their vast proportions, moreover, indicate enormous strength and show that the limbs had a further office than simply to support the body. In no other respect does the Megatherium differ more strikingly from existing quadrupeds of corresponding bulk. The scapula is a vast expanse of bone, two and a half feet in its greatest length,



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* An analagous disposition of hard and soft vertical layers occurs on a still larger scale in the teeth of the Elephant, but in this gigantic leaf-feeding quadruped we find a different plan of repairing the wear; new teeth being supplied from below to replace the old ones which fall out.

Owen, in speaking of the character of the Megatheroid tooth (Zoölogy of the Beagle, page 33), says: "Besides the relation to food requiring much comminution, which teeth with persistent bulbs bear, they are also connected with the *longevity of the individual.* The term of life in a herbivorous animal, with grinders of temporary growth, is of course dependent on the duration of these essential aids to nutrition. Thus a sheep wears down its grinders in twelve years, and its life is consequently limited to about that period."

and of triangular form. The vigor of the muscles attached to it is manifested by the spines and ridges on its outer surface. The confluence of the acromium with the coracoid process is a peculiarity which the Megatherium shares with the modern Sloths. The glenoid cavity is elliptical, and its greatest diameter is six and a half inches. The clavicle is 15 inches in length, and much resembles that of man in shape.* The humerus and the fore-arm by the development of their inequalities bespeak the great volume and force of the muscular masses which surrounded them. The distal end of the humerus is so flattened vertically, and extended at its sides as to be 13 inches in width; that of the Rhinoceros being only one-third as large, and the Elphant's only one-fourth. The head of the radius has a shallow, concave, articular surface, which allows quite as much rotary movement as in the arm of man. The ulna is peculiar by reason of the great expansion of its proximal end in connexion with its long and slender shaft. The fore foot consists of 7 carpal bones, 5 metacarpal, and 10 phalanges. The 2d, 3d and 4th digits were furnished with claws. The place of the thumb was held by a stunted metacarpal. The entire length of the fore-leg, with the foot, is seven feet and four inches, and its proportions are in harmony with the rest of the animal structure.

The *Posterior Extremities* are shorter than the anterior. The pelvis, which forms the most striking feature in the skeleton, is the largest single bone of any land animal either living, or extinct. Its extreme breadth is upwards of five feet, being sixteen inches broader than the pelvis of the Asiatic Elephant. Viewed in front, the two iliac bones resemble a pair of outstretched wings, the concave surfaces facing the head. The two sides of the pubis unite in a long, slender, wedge-shaped bone, reaching downwards and forwards at right angles to the transverse axis of the superior ilia and ischia. The socket for the head of the femur is a well-defined oval cavity, the concave surface of which measures nearly forty-four square inches; the atmospheric pressure upon the hip-joint of the animal is 660 pounds.† The thigh-bones of the Mastodon and Elephant appear weak and slender when compared with the massive femur of the Megatherium. It is about two feet four inches long by three feet two inches in circumference at the largest part, and its surface is roughened by two rugged trochanters. It is much flattened before and behind, and the anterior surface of the shaft is so hollowed out as to form quite an arc with a line drawn between the two extremities of the bone. The distal extremity joins firmly, with two articular surfaces, to the upper end of the tibia. The tibia and fibula are anchylosed together at both extremities, by which their strength is much increased. Altogether the hind legs appear more like columns for support than organs of locomotion. Their articulation with the feet is admirably contrived for supporting the enormous pressure of downward weight, which is transmitted to the middle of the pedal arch. The astragalus, or great bone of the instep, is 9 inches broad, and the same in height. Its articular surface is so placed upon the *inner* side, that the foot, when joined to the leg, is raised from the ground, and rests entirely on its outer edge,—a position which must have precluded all rapid progression upon the part of the animal. The heel-bone has the extraordinary length of 17 inches, and a circumference of 28; occupying nearly one half the entire length of the foot. The innermost of the three developed toes is modified for the firm fixation of a powerful claw, the sheath measuring 13 inches in circumference. The total number of bones in the hind-foot is eleven, forming altogether a model of massive organic masonry.

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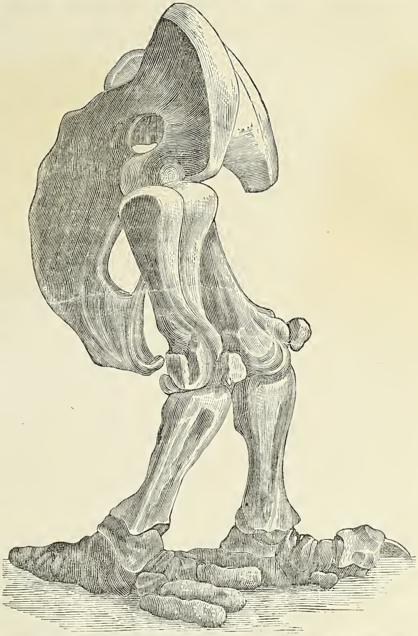
* The Megatherium had the largest clavicle of any animal of geological times, as has man among all animals of the present creation.

† How does the anatomy of this huge beast contrast with that of some other animals which, in point of size, hold their place at the other end of the long series of Mammalian forms. In the Megatherium the cavity of the acetabulum is eight inches in diameter; in the pigmy Shrew Mouse—Sorex araneus—it is about one half of a line across, or only about *one two hundredth* of the former dimension!



The *Tail* of the Megatherium strikes every observer with wonder on account of its enormous magnitude. It exceeds in its massive strength the same member in any other animal which has ever walked upon the earth. Its vertebræ dwindle rapidly down from the first, which measures twenty-two inches across from point to point of its transverse processes, to the 18th, which is less than two inches in diameter. These processes, as well as the V-shaped bones (the confluent hæmapophyses — *chevron bones* of Cuvier) hanging below the first eleven vertebræ, formed the attachment for powerful muscles acting from the sides and below, and the neural canal, which runs through the whole, attests by its very unusual size to the vigorous and powerful movements of this caudal appendage. Such a tail, with a circumference of six feet at its greater end, must have been a formidable weapon in giving a side blow, while, bent downwards at a sharp angle, so as to rest upon the ground, it would form with the hind legs a very firm support or tripod, from which, as a fulcrum, the huge animal could effect the swaying movements of the rest of its body when obtaining its food. The extreme length of the skeleton, as mounted in the Museum, is seventeen feet and nine inches; its height, from the pedestal on which it stands to the top of the spinous process of the 1st dorsal vertebra, is seven feet. In the table at the close are given a series of measurements of different bones of the Megatherium, and we have added to the list, for the sake of comparison, the measurements of the same bones of an adult female elephant, as given by Cuvier in his *Ossements Fossiles*.

§ 3. PHYSIOLOGICAL FEATURES.

Let us now imagine the bony frame-work of this gigantic animal clothed with flesh and instinct with life. There towers up before us a huge, ungainly beast, eighteen feet in length and eight feet high, having a Tapir-like head, an elephantine body, and hind feet and tail which find no match in geologic or historic time. Such mammoth haunches, nearly 6 feet across; such singular extremities; so slow in his movements; and so stupid in look,—we wonder at the strange part he must have played in the economy of the ancient world. We see him the lord of the Pampas,—swaying a wider realm than the Incas of Peru; for his size and strength most certainly placed him at the head of the Animal Kingdom. The brain of the Megatherium must have been less by nearly one half than that of the Elephant; for the vertical diameter of the cranial cavity is only 4⅔ inches, and the transverse diameter but six. We infer from this, as well as from other features, that it was a creature of fewer instincts than the present monarch of terrestrial mammals. The general proportions of the former resembled, with some variations, those of the latter. Its body was relatively as large; its head much smaller; its legs shorter and thicker; and its neck a very little longer. It probably exceeded more than a hundred-fold the bulk of any living Edentate. Its thick and callous hide was very probably scantily clothed with coarse, stiff hair, like the Elephant's.* Its prehensile organs were well supplied. To the tongue of a Giraffe and the proboscis of a Tapir there was added a perfectly developed clavicle, and the power of rotating the bones of the fore-arm. The vertebræ of the neck show, moreover, by their articular surfaces, the freedom with which the animal's head was carried in all directions in front of the body. As we have before observed, the monster walked, like the Ant-eater, on the outside edge of its fore-feet, on a marginal, hoof-like callosity, resting mainly on the fifth finger and the joint of the fourth, with the superior, claw-bearing toes bent inwards. The feet presented a combination, hitherto unknown, of ungulate and unguiculate characters. At the same time, the very arrangement of the bones, which permits the co-existence of hoofs and claws in the same foot, in a great measure provides also for the efficiency of the unguiculate digits in their application to the violent exertions which were habitual to the living animal. While in the Cat tribe the claws are kept sharp and serviceable by the mechanism for their retraction, in the Megatherium the same effect was gained, and they were prevented from impeding the march of the animal, by their oblique introflection, and by the concentration of the superincumbent weight on the outer toes. The extreme length of the fore-foot from the top of the wrist to the tip of the claw was 28 inches. The sole of the hind-foot was also turned inwards, ; and its rough surface bespeaks the thick and callous integument with which it was shod. The long heel afforded a firm posterior fulcrum; while the powerful claw of the middle toe kept the foot fixed upon the earth at the moment when the forces of the fore-limbs were exerted. The hind-foot, a full yard in length, stood at right angles with the leg, and, with its inward turned heel, gave a suitable base to the massive column above. The rugged ilium and spinal crest proclaim the pelvis to have been the centre of muscular masses of enormous power, which diverged to act upon the trunk, the tail, and the hind-legs. These muscles, if we may judge from the great size of the spinal cord, which in this region is 4 inches in diameter, must have been characterized by the extreme energy of their vital contractility.* The unusual size of the sacral foramina,—far larger in their proportions to the other nervous canals than we find them in other animals,—shows the concentration of force in the posterior extremities. The acetabulum is excavated in a very exceptional manner, its concavity facing directly *downwards*. Setting in this way over the head of the femur, there is a great increase of strength for sustaining vertical pressure, but attended with a diminished capability of rapid motion. But the animal had no need of agility, for it was not carnivorous ; neither for flight, for any cotemporary foe that ventured to cope with him could be laid in the dust by a single blow of his paw. We are anxious to know the daily habits, food, &c., of an animal whose bony frame-work offers so many and exceptional peculiarities of structure, united to such colossal dimensions. That the Megatherium was not carnivorous is settled by the structure of its molar teeth,—the only ones of the whole series which it possesses. Its lack of incisive teeth forbids our seeking its living analogue among those Ruminants or Pachyderms whose food is grass. We have already noticed the similarity of its teeth to those of the Sloth ; and, following the safe physiological rule, that animals having the same dental structure have the same kind of food, we come to the conclusion that, like the modern tardigrade, the Megatherium lived upon the foliage of trees. The elephant and the Giraffe,—the largest of the few leaf-feeders of the present day,—present remarkable modifications of their organic structure relating to the acquisition of such food ; the one gathered in the branches with its long proboscis ; the other, standing on its stilt-like fore-legs, and reaching out its attenuated neck, plucked the higher boughs with its long and flexible lips and muscular tongue. The Megatherium possessed both of these prehensile organs (as we have judged from the pre-nasal and inter-buccal orifices for the passage of their nerves), yet with a much less development of the proboscis. We must evidently look to some other parts of its body for its most efficient instruments in obtaining its food. The question arises as to whether the animal sought its leafy pabulum after the mode of the modern Sloth,—by climbing. Was it scansorial ? We have before noticed the conjecture of Dr. Lund, that the huge monster once climbed, like a Bear, along the branches of the giant trees which then clothed the continent of South America, steadying itself, and even swinging from bough to bough, by means of a prehensile tail. The most obvious objection to this view is the immense bulk and weight of the creature, as well as its clumsy make. The large and well-developed clavicle indicates only the freedom with which the monster moved its fore-limbs, as we now see in those animals which carry their food to their mouths in their paws. It does not prove the Megatherium a *climbing* animal ; for the Bear, the heaviest animal now gifted with this faculty, has not even the rudiments of a clavicle, and in one species of Sloth this bone is incomplete. The structure of the fore-foot, moreover, militates against the theory ; for the outer digit is modified, after the hoof type, for the exclusive office of supporting the body in ordinary terrestrial progression. In the best climbing animals the hind-legs are much shorter than the fore-legs, and the pelvis is not extraordinary in size, as we find it in the Megatherium. The preponderating weight of this part is a riddle, on the scansorial hypothesis ; for the hind extremities, needing only the requisite prehensile power, ought to have had their bulk reduced in order to facilitate their being drawn upwards towards the fore-legs. As to the tail, it was too short for prehensile purposes ; besides, the articular surfaces of the vertebræ show that the ordinary inflection was not forwards but backwards and downwards, as in the Kangaroo. Another question relates to the fossorial powers of the Megatherium ; did it habitually burrow, like the Rabbit or Mole ? In this latter animal;—so typical as an excavator,—the pelvis is remarkably slender and feeble ; in the Megatherium it is remarkably large. Clavicles, though commonly present in burrowing Mammals are not indispensable ; for they are wanting in the Badger, and are merely rudimentary in the Rabbit and the Fox. In animals whose feet are best organized for digging, the claws form a continuous plane with the palm of the foot, and they are broader than they are deep. In the Megatherium, on the contrary, the depth of the claw-phalanx much exceeds the breadth; and not one of the claws can be brought into a line with the metacarpus, but all are more or less bent inwards and downward. Such an insertion of the claws would singularly interfere with their efficiency as instruments for excavation. Though they might be used for occasional acts of scratching up the soil, they are evidently best adapted for *grasping.* The theory of Prof. Owen is, then, in all probability, the true one ; that the Megatherium was neither a climber nor a burrower, but that his great strength was given him for the purpose of uprooting the trees that bore his sustenance, or for breaking off the largest of their lower branches. The hand of the monster beast cannot be contemplated without the conviction that it was designed to overcome unusual resistance ; evidence of which is furnished by the deep groves and sharp ridges in the radius and ulna,—the starting points of stout tendons and muscles. All the bones, from the shoulder down, are eminently suggestive of prodigious force. The moment we estimate this force, the colossal proportions of the hind extremities lose their anomaly, and harmonize with the front. The application of the fore-arms to the work of tearing down a tree would demand a corresponding fulcrum, such as we find in the heavy pelvis and the massive hind legs. The earth was probably first removed from the roots by the claw of the hind-foot, which, like a pickaxe, was well adapted for that purpose.

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* We are led to make this conjecture as to the probable outer covering of the Megatherium, from the character, in this respect, of the Elephant, Rhinoceros, Tapir, and other huge Herbivora of the present period. But it is still well to bear in mind that it is in the Edentates among Mammals that we find the most extreme,—as the fullest—developments of the tegumentary system. The Megatherium may, perchance, have had as abundant and as peculiar a covering as has the shaggy, coarse-haired Sloth; the Phatagin with its acute, imbricated scales; or the Armadillo with its stiff coat of mail.

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* The few modern Sloths which have been kept alive in menageries have astonished every spectator by the immense muscular force which they exerted with their fore and hind legs.

" The tree being thus partly undermined and firmly grappled with, the muscles of the trunk, the pelvis and hind limbs, animated by the nervous influence of the unusually large spinal cord, would combine their forces with those of the anterior members in the efforts at prostration. And now let us picture to ourselves the massive frame of the Megatherium, convulsed with the mighty wrestling, every vibrating fibre reacting upon its bony attachment with a force which the sharp and strong crests and apophyses loudly bespeak :—extraordinary must have been the strength and proportions of that tree, which, rocked to and fro, to right and left, in such an embrace, could long withstand the efforts of its ponderous assailant."*

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* Owen on the Mylodon, p. 148.

Such, as we have described it, was the Megatherium in its form, and such was, according to all physiological probability, its mode of obtaining its food. Of its further habits we can form little estimate. In following the analogy lent us by the living sloth, we may consider that the huge extinct animal once roamed the plains in solitary loneliness; or that at best there were but three or four individuals in a herd together. Indeed, the necessities of the creature, to secure an enormous daily supply of food, would have obliged the individuals to have separated widely, unless the vegetation which clothed the pampas in that earlier period, were far less sparse than that which we see there at the present day. The gathering in troops, as we see among many of the grass-feeding Ruminants, for purposes of self-defence, was not a necessity for these ponderous Edentates, whose size alone must have been, as we have before remarked, a protection against any living foe; nor were they drawn together in flocks by those influences which cause polygamous animals thus to congregate. The Megatherium was, doubtless, like the Sloth, uniparous, giving birth, after a long period of gestation, to a single large young, which would for a long time receive the care of one or both parents, before it could itself undertake the arduous efforts which its mode of feeding required. The progression of the animal upon the ground was doubtless much more rapid than that of its modern, tardigrade, successor, whose whole organization is modified for its home in the trees ; but it still probably never taxed the limited sustaining capacities of its mutilated outer toes by any pace more rapid than a walk. Much of its time must have been spent in stripping the trees which it had prostrated, and its position was then doubtless a reclining one; its hind extremities folded beneath its body, and its fore-legs bent at the elbow, allowing its chest to rest fully upon the ground, and its fore-arm and hand to be free for bringing one after another to its mouth the light boughs of the fallen tree. Indeed, Prof. Agassiz has ventured the opinion* that this crouching attitude was constant to the animal, and that it crept along with the full length of its fore-arm resting upon the ground,—a mode of progression which is said to be adopted by the modern Sloth, when making its painful transit along the ground from one tree to another. But of whatever kind were the locomotive actions of the Megatherium, we feel sure that they were *slow* ones. Had we beheld it living on its native plains, its slowness of movement would probably have excited our wonder even more than its colossal size.

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§ 4. ZOÖLOGICAL POSITION.

The position which the Megatherium holds in the long series of Mammalian forms was first scientifically determined by Cuvier. He referred it to the order of the Edentates—an order which, at the present day, is remarkable for the *bizarre* and aberrant forms which it contains. The Anteaters, the Armadillos, and the Sloths—its three great groups—present few features in common, save their feeble dentition ; all the teeth being wanting in the former and the molars alone being present in the latter. The present representatives of the order are few in number, and but pigmies when compared with the huge creatures of allied structure which once dwelt upon the earth. Cuvier also showed that it was to the Tardigrade division of this group—the Sloth—that the Megatherium bore its closest affinities. These strange, uncouth animals now inhabit the forests of South America, where they spend their whole lifetime in the trees, finding their entire food and sustenance in the leaves, which they strip from the highest and outermost branches. They are represented by but two species, the largest of which does not exceed two feet in length. No other fossil so exceeds in size its modern representative, as the Megatherium surpasses the pigmy remnant of the Tardigrade race. A Spanish critic made this objection to the place assigned to the Megatherium by Cuvier, that "all the other Edentates could dance in his carcass." The character of the teeth affords the crowning proof that it is to the diminutive arboreal Sloth that the great extinct quadruped has the closest affinity. The number of the teeth, their deep insertion, equable breadth and thickness, absence of fangs, deeply excavated base, inner structure, and unlimited growth, are characters common to both. The dental system here, in the order of Edentates, finds its lowest condition among Mammalia. The Sloths have the same anomalous shortness of face as the Megatherium, although, with them, the features is carried to a greater extent; the cerebral cavity is masked by a similar development of air-cells; and the alveoli of both jaws correspond in number, position and relative depth.

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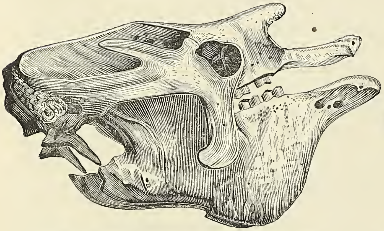
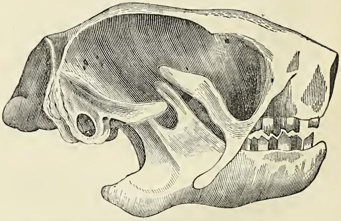
* Proc. Bost. Soc. Nat. Hist., ix., 193.

The remarkable process hanging down from the zygomatic arch is a strange peculiarity which the Sloth alone among living animals retains, although it was possessed by a number of the Edentates (of two families), which are now found fossil. These similarities between the two heads are quite apparent when they are viewed side by side, as in the accompanying cuts. In the peculiar length of the premaxilliaries, the Megatherium differs from its living congener, whose shorter tongue required no such support beneath. In the prolongation of the slender fore-part of the upper jaw, it approaches the Anteater, and, as a general rule, in those modifications of structure by which the Megatherium differs from the Sloth, it approximates the Anteater, and, in a minor degree, the Orycterope and Armadillo. Thus, in the number and structure of the true vertebræ, the fossil Edentate departs from the Sloth, and agrees



Skull of Megatherium Cuvieri, one-ninth natural size.



Skull of Sloth (Bradypus tridactylus), natural size.

with the Great Anteater. The Three-toed Sloth has two more cervical vertebræ, while the Two-toed has eight additional dorsals, the greatest number known in any Mammalian quadruped. All the Edentates have ossified sternal ribs like the Megatherium, but the Sloths come nearest in having their first three ribs anchylosed to their sternal complements. Only the Sloths and Anteaters resemble the Megatherium in the small number of the lumbar vertebræ; the latter have also the same number in the sacral region. The part of the skeleton in which the Megatherium differs most from the Sloths is the tail, which in these latter is so short as to be hardly visible. In the *terrestrial* Edentates, on the other hand, there is the same extended and complex development of that member which we have observed in the ground-going fossil.

The scapula of the Megatherium, in the confluence of the acromium with the coracoid, exclusively resembles that of the Sloth. In its clavicle and carpus it approaches nearest to the Unau; in the bones of the fore-foot it corresponds more closely with the Ai. The characters of the humerus and ulna are most closely repeated in the Great An-eater. The fore-legs of the Sloth are nearly twice the length of the hind ones, and in this respect differ from the Megatherium. All the Edentates have the ischiatic notch nearly closed with solid bone, like the Megatherium, but the Sloths alone imitate the expanded ilia. They also repeat the wide flattening of the femur with the absence of its medullary cavity.* The Sloths have the prolongation of the heel, and, alone among living Edentates, suppress certain toes. The Megatherium presents alike an exception to the rule that unguiculated mammals have penta-dactyle feet; since not even a vestige of the inner toe exists. The conclusion of this zoological comparison is, that the Megatherium finds its nearest living analogue in the Sloth family, of the order of Edentates. It agrees with the Sloth chiefly in the structure and growth of its teeth; it differs chiefly in the peculiar length of the pre-maxillaries, and in the possession of a long tail. Being neither a climber nor a burrower, its position is expressed by the term applied to it by Owen—"The Giant Ground-Sloth of America." The species under consideration is named *M. Cuvieri* by Demarest, and *M. Americanum* by Owen; while the species found in North America is distinguished by Leidy as the *M. mirabile*. The new primary group, or tribe, of leaf-eating edentates, which Owen has established under the name of PHYLLOPHAGA, includes, together with the living Sloths, the fossil genera, Megalonyx, Megatherium, Mylodon, and Scelidotherium. The former and the latter of these fossils are known only by a few fragmentary portions of their skeletons, which are, however, still sufficient to indicate their place with the two other ponderous forms, and with them to constitute the natural family to which the same author has given the expressive appellation of GRAVIGRADA.

The Mylodon,—of which a very perfect skeleton was fonnd in the same Pampean formation of Brazil,—approached the Megatherium very closely in general form, although it was only about two thirds as large. Its skull was very similar, save in the fact that it lacked the extended pre-maxillary bones, and the lower jaw was not so largely developed downwards for the implanting of long-rooted teeth. Its dental formula was the same, but the teeth were of a structure slightly less simple than those of the Megatherium. The vertebral column of the Mylodon, moreover, presented notable peculiarities which distinguished it from its larger congener. The lumbar vertebræ were not free, but were anchylosed firmly to each other and to the sacrum, forming of the whole a long, massive arch,—a structure peculiar to Birds in the present creation. It is interesting to contemplate these Megatheroid animals in their relations to the leaf-eating quadrupeds of the present day. The elephant, the largest of existing phyllophagous animals, is characterized by a maximized proboscis, by which, as with a long dexterous arm, it wrenches off the lower branches of trees, and gathers their leaves to convey them to his almost tongueless mouth. The proboscis thus becomes, for this monarch of beasts, the organ upon which its whole existence depends, and which brings the rest of its structure in harmony with the necessities of its life. The Giraffe possesses another and entirely different mechanism for gaining the same final end. Elevated by means of fore-legs and a neck which are both of unparalleled longitudinal extension, the head is itself brought to the height of the boughs, from which it rapidly strips the leaves and tender twigs, by seizing them with its flexible lips and long muscular tongue. The Sloth, with its short, lighter body, leaves the ground entirely, and, climbing up along the higher and outer branches, uses its long arms and hooked claws in drawing the ends of the slender boughs so near to it that it can browse upon their leafy extremities. The structure of these three animals, although so diverse, admirably adapts them to a common food. But what modifications of the bodily frame could have permitted animals of approximate bulk to the Elephant and Giraffe, yet neither proboscidian nor of towering stature, to have fed like them upon the high-waving branches of trees, is a problem in comparative anatomy which the fossil bones of the Megatheroids have alone enabled us to solve. The great prototype of the modern Sloth could neither reach up to the branches which it coveted, nor attain to them by climbing in the tree itself; but its strong arms could seize the trunk with a vice-like grasp, and, acting in unison with the muscles of its immense hinder extremities, could sway it back and forth, until it fell prostrate, bringing with it its large supply of choice nourishment. It would be difficult to conceive of any modifications of the Sloth's structure whereby a creature of like needs, yet of dimensions so immense as to totally unfit it for an abode in trees, might still derive from them its sustenance, more simple and more effectual than those which the skeleton of the Megatherium has shown us.

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* The anchylosed condition of the tibia and fibula, as seen in the Megatherium, is known among existing quadrupeds only in armor-bearing Edentates. The hemispherical excavation of the articular surface on the distal end of the tibia is peculiar to the Megatherium and the Mylodon, nor has any living Mammal the astragalus of the Megatheroid quadrupeds,—it being the most characteristic single bone in the skeleton.

§ 5. GEOLOGICAL AGE.

South America is the metropolis of the Edentates. It now contains nearly three times as many species as are found in all the other continents. They are here represented by the three families of Sloths, Ant-eaters, and Armadillos. The Sloths are peculiar to the region between Honduras and Rio Janeiro. Their distribution in ancient times, when their gigantic predecessors—the Megatheroids— walked the earth, was far more extensive, reaching from Virginia to Patagonia. The Pampas, where remains of the great fossil noticed in our sketch have been chiefly found, are vast plains, 1,500,000 square miles in area, stretching from Terra del Fuego to the Mountains of Brazil. Palms grow at one end, while snow covers the other almost all the year round. Generally speaking, it is the most barren tract in South America. In Patagonia it is an almost unbroken sheet of shingle and basalt rocks, diversified with huge boulders. In Buenos Ayres it is nearly as level as the sea, interrupted only at vast distances by the solitary Umbir. With the exception of this single tree, and the Palm and Orange groves on the banks of the La Plata, the chief vegetation is long wire-grass and thistles. Having been exempt, by reason of their warmer latitude, from the floating ice which, at a prior period, covered with gravel and boulders the then submerged plains of Patagonia, this Pampa does not offer to the eye a single pebble over a surface of hundreds of miles in length. Numerous salt lakes alone occupy depressions in the surface of the alluvium. The soil is almost wholly a dull reddish, slightly indurated, argillaceous earth, with here and there calcareous concretions. Underneath are beds of stratified gravel or conglomerate. These deposits constitute the Pampean formation, which varies in depth from 20 to 100 feet. They were slowly and quietly formed at a time when the Atlantic Ocean,—exceeding its present boundaries,—reached far westward to the foot of the central mountain chain, down whose flanks the smaller streams and rivers brought the detritus, and spread it beneath the waters in level layers at some distance from the shore. The carcasses of animals existing in the country floated down upon the same streams, and, reaching the still water of the sea, sank down to their muddy bed. The whole area has since been elevated ; the estuary mud of former rivers has been converted into wide and level plains, and the shores and submarine banks of a former sea now form low headlands along the present shore.* There is no considerable superficial erosion, as would have been seen had the upheaval been a violent one, and accompanied with powerful marine currents. Most of the Mollusca, barnacles and corals discovered in this deposit are still living in the contiguous ocean,—a proof that the formation has been correctly referred to the pleistocene period. It is in this recent formation, a perfect hecatomb of monsters of extinct races, that the Megatherium has been found entombed. The remains are found almost exclusively in the cliffs and steep banks of rivers, yet at all depths from the top to the bottom of the deposit.

Most of the bones are in a soft and friable condition, and, like the shells in the same deposit, do not emit when burnt an animal odor. Many of them have been broken, abraded and rolled; while to others, barnacles, serpulæ and corallines were attached in the long period which elapsed before they were entirely covered by the mud. But the largest number of them are quite uninjured, and retain all their minutest prominences perfectly preserved, showing that they were protected by flesh or ligaments while being buried. The parts of the great Scelidotherium discovered in the same deposit by Darwin were all found lying in their proper relative position, even to such small bones as the knee-cap. The great abundance of these remains of land animals lead us to look upon some large areas of these Pampas as estuary deposits. We may suppose that ages ago great bays of the ocean occupied these areas. That into these bays the vast tributaries of the Plata brought down the carcasses of the gigantic Mammals, and there, acted upon by currents, they drifted to the points where sand and shingle were accumulating in shoals. The only physical change since that time has been a gradual rising of the continent. Once buried, no cataclysm has disturbed their quiet rest. The North American species of the Megatherium lived in the same pleistocene period. Skiddaway island—an upper tertiary formation, consists of flat sandy banks rising but a few feet above the level of high tide,—and overlying beds containing marine shells belonging to forty-five species now inhabiting the neighboring sea.

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* This elevation, however, was interrupted by several poriods of rest, as may be inferred from the plains cliffs, and lines of sand-dunes existing at different heights. The beds now stand from 15 to 20 feet above the level of high water.

It is interesting to consider the condition of our western continent at an age so immediately antecedent to the introduction of Man. The contour of the coast lines was already defined, and the external features of the country were nearly the same which they now are. The lofty Andes had just been lifted up, and taken their place among the mountain ranges of our globe. Their newly made slopes were already furrowed by the same water courses which now feed the mighty La Plata, and the vegetation of the then more restricted Pampas differed little from that at present characteristic of them. Forest trees were dotted about at intervals, and fringed the banks of rivers and lagunes; but as a whole, the vast plain, as now, was

"Barren and bare, unsightly, unadorned."

The statement that a giant race of leaf-eating quadrupeds then roamed these plains need not too seriously try our faith. For a survey of living nature shows that no close relation exists between the *bulk* of the animal species and the *quantity* of the vegetation, in the countries where the Mammalia abound. The Camel, an animal of no mean size, has lived, and found its sustenance, for ages, on the sterile desert. South Africa, with its scanty vegetation (ten times less than that of Great Britain) supports larger herbivorous quadrupeds than luxuriant South America. We owe this latter statement to Mr. Darwin, who says further that the average weight of the ten largest animals in the former country is 6,048 pounds, while in South America it is but 250 pounds,—a ratio of 24 to 1 in favor of the dry African plain with its sparsely scattered shrubs. The number of animals which lived on or near the early Brazilian Pampas is surprisingly great. Darwin found no less than nine huge skeletons at Punta Alta within a space of about 200 yards square. He says, moreover, that a trench could probably not be cut across these plains in any direction without intersecting and laying bare some of their remains.*

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* The manner in which this vast sepulchre of extinct quadrupeds has received its burden is one of the first questions which their contemplation suggests. We are disposed to accept Mr. Darwin's view concerning the physical conditions under which the Pampas were formed, and we readily conceive of the immense freight of

Let us suppose these animals once more upon their feet and clothed with flesh—each obeying his own native instinct. We are at a spot upon the wide plain where numerous bare trunks of trees, stripped of their verdure and decaying upon the ground, mark the vicinity of the great leaf-eating tribe. A group of the smaller Megatheroid animals—each one, indeed, a giant in his way—are following along this line of devastation, feeding upon such smaller bushes as may still remain, tearing them up by the roots, or browsing their low bending branches. Yonder is a Megalonyx, resting on his haunches, and, with his long arm and claw reaching over the spiny fence of the protruding leaves of the gigantic aloe, is wrenching out its saccharine stalk. Near by, the kindred Mylodon is lifting itself up, Kangaroo-like, against the trunk of a still upright tree, and is busily engaged with its fore-arm in breaking off the lower branches. Another great Sloth,—the Scelidotherium—walks leisurely here and there, browsing upon the flowery cactus. But presently the Megatherium himself appears, toiling slowly on from some great tree recently laid low and stripped of its leafy covering. The earth groans under the enormous mass; each step pushes one side or crushes beneath it the plants which grow in its path; but the monster continues to advance towards a noble tree, which until now has been unassailed, the monarch of the primeval forest. For awhile he pauses before it, as if doubting whether, having resisted the storms of so many seasons, it will yield even to his vast strength. But soon his resolution is taken. Having set himself to the task, he first loosens the soil around the larger roots by means of his powerful claws, stopping at times to rest himself and to contemplate the mighty task which is before him. Then, marching close to the tree, he plants carefully and firmly his monstrous hind-feet, striking their claws deeply into the ground. Then lifting himself slowly upon these, and upon his massive tail, bent downwards to assist in his support, he grasps the trunk with his fore-legs at as great a height as possible, grappling it with his claws, and nerving for the effort all the muscles of his powerful frame.

Then, suddenly throwing the immense weight of its body first to one side and then to the other, in its mighty wrestling, it sways the tree to and fro, with the force of a hundred giants, causing it to tremble to its topmost bough, and at length it falls with a fearful crash. The animal, although shaken and weary with the mighty effort, moves forward to its branching top, when, having assumed a reclining position, it at once proceeds to strip off every green twig. Leaving the huge beast, we discover, by the borders of a swampy tract, one of the strangest animals which ever existed. This is the Toxodon—an elephantive monster related to the Gnawers, yet aquatic like the Dugong and Manatee. Further off upon the plain, we see the Macrauchenia—half Camel, half Tapir in its structure; while from another side slowly advances with heavy tread the Glyptodon with its ponderous coat of mail. A troup of wild

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animal carcasses which a mighty river like the Plata would bear down upon the waters of its periodical freshets, and deposit far and wide in the muddy shoals one either side of its mouth. Lyell, in his *Principles of Geology*, (chapter xlviiii.) has collected numerous instances of the vast destruction of wild and domestic animals which accompanies the sudden floods to which many large rivers in various parts of the world are liable. Sir Woodbine Parish, in speaking of one of these inundations of the Parana—a tributary of the Plata,—says that vast herds of cattle were swept away, "and when the waters began to subside, and the islands which they had covered became again visible, the whole atmosphere for a time was poisoned by the effluvia from the innumerable carcasses of skunks, capybaras, tigers, and other wild beasts which had been drowned."

Horses comes galloping by, closely pursued by the sabre-toothed Lion—the fearful Machairodus. A Mastodon, an Ape, and a Dog complete the picture. Such were the animal forms which covered the Pampas in the Pleistocene period. We notice with interest their close family alliance to the genera of Mammalia now inhabiting South America, and the notable differences between them and their fossil cotemporaries in the Old World. They are but one illustration among many of a general law, deducible from the fossil animals of the eras immediately antecedent to the human, that, with extinct as with existing Mammalia, particular forms were assigned to particular provinces, and that the *same* forms were restricted to the *same* provinces at a former geological period that they are at the present day.

We have noticed the numerous monster fossil Edentates which gave place in South America to the Sloths, Anteaters and Armadillos which are now the characteristic forms of that continent. In like manner Australia had its Nototherium, Macropus Titan, Diprotodon, Thylacoleo, and other forms of herbivorous and carnivorous Marsupials, which represented on a huger scale the peculiar fauna which inhabits that continent at the present day. A race of gigantic wingless birds—Dinornis, Palapteryx—were in New Zealand, in a period, which seems to have blended with the actual one, the lordly prototypes of the strange Apteryx which now hides in the thick grass-tufts of that island. The stately Megaceros of Ireland yielded its place to the modern Fallow-deer: the Cave-bear of Continental Europe to the smaller Brown Bear of the present day. There are indeed some cosmopolite genera, such as the Mastodon, the Mammoth, and the Horse, which were simultaneously represented by different fossil species over nearly the entire extent of both the eastern and western hemispheres; but the few exceptions of this kind by no means invalidate the rule which we have given.

The former distribution of the Megatheroid animals concurs with other facts in showing us that the continents of North and South America did not, at that time form two distinct zoological provinces as they do at the present day. They even give us an index of the time when the great plateau of Central Mexico was lifted up to its present position, thenceforth to form a physicial barrier between the two continents which few animal species could cross. The whole period during which these large quadrupeds roamed upon the plains of South America, is far shorter than the life-time of their cotemporary invertebrate species; for the same species of marine shells which are found imbedded in the very lowest deposits in which the Megatherian remains occur, are still living in abundance in the adjacent ocean. There are, moreover, features in the constitution of land animals which render them far more obnoxious than are others, to the extirpating influences that accompany the changes of general physical conditions which are constantly supervening in every country. And also in proportion to the bulk of the animal is the difficulty of the contest which, as a living organism, it has to maintain against these destroying agencies. "Any changes," says Prof. Owen, in such external agencies as a species may have been originally adapted to exist in, will militate against that existence in a degree proportionate to the bulk of the species. If a dry season be gradually prolonged, the large Mammal will suffer from the draught sooner than the small one; if such alteration of climate affects the quantity of vegetable food, the bulky Herbivore will first feel the effects of stinted nourishment; if new enemies be introduced, the large and conspicuous animal will fall a prey, while the smaller kinds conceal themselves, and escape."* The early destruction of the Megatherium and its huge congeners must then not surprise us.

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* Owen on the genus *Dinornis;* Trans. of Zoöl. Soc., vol. iv: p. 15.

Nor need we complain because we cannot tell positively, which of them first left the stage of existence, nor how many years it is since the last member of the race became extinct. We feel confident that they were not extirpated by human agency, that no primæval Indians disputed the lordship of the plains with the Edentate giants. Nor was the glacial period the agent of their destruction, for they lived subsequently to that event. We conclude that all, both small and great, were annihilated one after another, in the lapse of indefinite ages, "by those changes of circumstances in the organic and inorganic world which are always in progress, and are capable in the course of time of greatly modifying the physical geography, climate, and all other conditions on which the continuance upon the earth of any living being must depend."*

Comparative Table of Dimensions of Megatherium Cuvieri, and adult (female) Asiatic Elephant.

	Megatherium.		Elephant.	
	Feet.	Inches.	Feet.	Inches.
HEAD.				
Length of skull (from occipital condyles to front of upper maxillaries)	2	7	2	10¾
Greatest vertical height of ditto	1	7	3	6
Breadth across widest part of zygomatic arches	1	6	2	4
Circumference in occipital region	1		2	3¾
Length of lower jaw	2	3	2	2¾
VERTEBRAL COLUMN.				
Length of the Cervical region	2	1	1	3¾
" " dorsal region	5	10	4	5¼
" " lumbar region	1	3		8
" " sacral region	1	4		9¾
" " tail	4	6	4	11
Breadth of largest caudal vertebræ	1	9		7
Whole length of vertebral column†	15		12	1¾
ANTERIOR EXTREMITY.				
Length of Scapula	2	6½	2	4¼
Breadth of "	1	5½	2	1
Length of Clavicle	1	3	wanting	
Length of Humerus	2	3	2	8¾
Breadth of distal end	1	3		10½
Length of Ulna	2	1½	2	4¾
Length of Radius	2	2	2	2½
Circumference of middle of fore-arm,	1	8	1	3
Length of fore-foot	2	4		
Breadth of "	1	1		
Length of Ungual phalanx of middle digit		10½		
Vertical diameter of ditto near the middle		6		
Whole length of fore-leg, with foot	7	4		

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* Lyell's Manual of Geology.

† The length of the vertebral column is measured upon the skeleton of the Megatherium, as it is mounted, without the intervertebral cartilages; the same was true of the Elephant's skeleton measured by Cuvier.

Posterior Extremity.	Megatherium.		Elephant.	
	Feet.	Inches.	Feet.	Inches.
Breadth of Pelvis, in widest expansion	5	1	3	8
Length of Femur, on inner side	2	4½	3	2½
Circumference of head of femur	2		1	4
" of middle of ditto	2	2	1	
Length of Tibia	1	10	1	10½
Circumference of middle of bones of leg	2		1	1
Length of hind-foot	2	10½		
Breadth "	1			
Length of Astragalus		9		
Breadth of "		9		
Length of Oscalcis	1	5		7½
Length of Ungual phalanx of middle digit, hind foot		9½		
Circumference of ditto near middle	1	2½		

We have added in the following pages a few words in relation to each of the ten bronze statues of Edentate animals which cap the posts of the railing that surrounds the great skeleton. They are, in the order in which they stand, the Pichiciego, Armadillo, Aard-Vark, Sloth, Mylodon, Little Ant-eater, Great Ant-eater, Phatagin—or Long-tailed Mavis—, Glyptodon, and Megalonyx.

PICHICIEGO.

(*Chlamyphorus truncatus*)

The Pichiciego—so called from the Indian word *pichi*, meaning small, and the Spanish, *ciego*, blind,—is a native of the province of Mendoza, Chili, where it inhabits the wooded country at the base of the Andes. Dr. Harlan, who established the genus in 1825, says, that "taken collectively, it furnishes us with an example of organic structure, if not unparalleled, at least not surpassed in the history of animals." Dr. Buckland regarded it as "one of the nearest approximations to the Megatherium, particularly in regard to its coat of mail, and in the adaptation of the animal for digging;" but he was mistaken as to the true characters of the great fossil. The Pichiciego, although scarcely six inches long, is formed on a plan of the utmost strength and solidity. It has a tesselated carapace, like the Armadillo, which is, however, connected with the back of the animal only by a ridge of muscle along the spine, and with the skull only by two bony prominences. This shield dips down abruptly over the haunches, so that the creature looks as if its body had been cut squarely off behind, whence its specific name, *truncatus*. The whole surface of the body, even under the shield, is covered with long silk-like hair, of a delicate straw color. The tail curls firmly under the belly, and its extremity is shaped like a paddle. The head is pointed; the eyes are very minute; and the molars number 16 in each jaw. The anterior extremities are short, thick, and powerful; the hand, furnished with five nails, constituting one of the most efficient instruments for shoveling the dirt which can be imagined. The hind-legs are comparatively weak, the feet being long and plantigrade, with small, flattened nails. The ribs are very thick, and capable of resisting great pressure. The animal lives, like the mole, under ground, feeds upon worms, and is not nocturnal. On these accounts it is very hard of capture; only *six* specimens being known in Museums, three of which are in the United States, and three in Europe.

ARMADILLO.

(*Dasypus peba.*)

The Armadillo, called also the Tatouhou, is confined in its geographical range to Guayana, Brazil, and Paraguay. It is about thirty inches in total length, the slender tapering tail being fourteen or fifteen inches long. Its color is dark brown and black. The armor, covering this animal, is a triangular or oval plate on the head, a large buckler on the shoulder, and a similar one over the haunches; while, over the middle of the body is a series of transverse bands, variable in number,* overlapping each other, and permitting the animal to move freely, and to roll up when it chooses. Each of these separate portions consists of a multitude of small parts consolidated together, presenting the appearance of mosaic-work. The tail is enveloped by a series of rings; and the skin of the under surface of the body is very rough, and beset with long scattered hairs. The muzzle is long, straight, and conical; the tongue long, narrow, pointed, and extensible; the teeth (all molars) fourteen in each jaw; the ears large; the eyes small; the limbs short and thick; and the feet covered by a hard, tuberculated skin. It burrows with great rapidity, dipping at an angle of 45 ; and is nocturnal in its habits. It runs with celerity, but in an odd manner. It goes scuttling along—automaton-like, no inflexion of the spine accompanying the movements of the limbs. The Armadillo sees indifferently, particularly in bright weather; but its senses of smell and hearing are very acute. Its food consists of fallen fruit, roots, worms, and carrion. It is hunted by the Indians, the Spaniards and the Portuguese by reason of the delicacy of its flesh. It is never found in the forest, but frequents the open and cultivated plains.

In zoölogical catalogues the Armadillo is found under the ambiguous names of *Dasypus septemcinctus*, *D. octocinctus*, and *D. novemcinctus*,—three different species having been thus established on the erroneous supposition that the number of immoveable bands was invariable in the same species.

AARD-VARK.

(*Orycteropus capensis.*)

This curious animal, sometimes called the African Ant-eater or Earth-Hog, inhabits the countries of the Cape Colony, and extends northwards to the Senegal. It is the only species of the genus Orycteropus, established by G. St. Hilaire in 1791. It resembles the Ant-eater in general habits, but is more like the Armadillo in anatomical structure. When full grown, it is about five feet long, the tail being twenty inches. The skin is thick and tough, and scantily covered with coarse bristles. It has a long, conical head, ending with a snout; the ears are long, large and pointed; eyes and mouth small. The teeth, all molars, 14 above and 12 below, resemble short pieces of cane cut off, with a multitude of little pores running lengthwise. The limbs are short, and very muscular; the fore-feet digitigrade and tetradactyle; the hind-feet, plantigrade and pentadactyle. The creature burrows with marvellous rapidity, and can bury itself in the ground faster with its hoof-like claws than a man can dig with a spade. In some districts the burrows are so numerous as to make it dangerous for cattle and horses travelling over the country. It lives upon ants, which it obtains by tearing down their hills, and then sweeping them into its mouth by its long, slender, glutinous tongue. It is slow of foot, and entirely nocturnal. The flesh of the hind-quarters, when made into hams, is accounted excellent.

SLOTH.

(*Bradypus didactylus.*)

The Unau, or Two-toed Sloth, is indigenous to the hot parts of America. It is clothed with coarse hair of a singular texture, resembling withered grass, patched with light and dark brown. Coarse at the extremity, it is fine as a spider's web at the root. The dental system is exceedingly simple. The teeth are all molars, ten in the upper jaw, and eight in the lower, but with the first one on each side of either jaw so set forward from the rest as to appear like one of the canine series. These teeth are cylinders of bone, made up of vascular dentine, ivory, and cement. The fore-limbs are twice as long as the hinder pair, and all four are terminated by hook-like claws, which are longer than the whole sole of the foot. These claws are bent inwards, and can be raised only by an effort, and that only in a slight degree. The natural position of the Sloth is swinging, suspended by its claws, *under* the branches of trees. It frequents particularly the *Cercopia*, on the buds and shoots of which it feeds. On the ground this animal is entirely out of its element; it can then drag itself slowly and painfully forward only by hitching its claws into any depression that may afford a hold. The zygomatic arch is bold and stout, but incomplete; the malar bone is well developed, giving off ascending and descending branches; there are no supernumerary cervical vertebræ as in the Ai. It has 23 pairs of ribs of lizard-like character; a pelvis like that of the bird in conformation and character; and the thigh-bones are directed obliquely outwards. The length of the Unau is about two feet

MYLODON.

(*Mylodon robustus.*)

The Sloth tribe was represented during the geological period immediately preceding the present by several gigantic Edentates. Among them, and second only to the Megatherium, is the Mylodon, whose fossil remains were discovered in 1841, buried twelve feet deep in the fluviatile deposits seven leagues north of the city of Buenos Ayres. It forms the subject of an elaborate memoir by Professor Owen. The skeleton, as mounted in the Royal College of Surgeons at London, measures eleven feet from the muzzle to the end of the tail, thus indicating a size about equal to that of the Hippopotamus. But the bones are more than proportionally massive. The pelvis, as broad as, and deeper than, that of the Elephant, rests on two massive, but short hind extremities, terminated by feet as long as the femora, set at right angles to the legs, as in plantigrade animals, but with the sole slightly turned inwards. The breadth of the largest caudal vertebræ is over 10 inches; length of os calcis, $7\frac{1}{2}$ inches; greatest circumference of the head of the femur, 15 inches; circumference of the trunk outside of the tenth pair of ribs, 8 feet and 2 inches; greatest length of scapula, 19 inches; length of clavicle, 8 inches; length of fore-foot, 14 inches; extreme length of skull, $18\frac{1}{2}$ inches. The skull, though smaller than that of the Ox, is long and narrow; and the lower jaw is wider than that of the Megatherium. The Mylodon had no proboscis, but the compensation was a very largely developed tongue. The palate was five inches wide, that of the Megatherium being only two. The teeth, simple, long, and fangless, resemble in structure those of its greater contemporary, but differ somewhat in shape, and in containing a less proportion of cement. The formula is M. $\frac{5}{4}\ \frac{5}{4} = 18$; the first molar being separated like a canine. All the true ribs are clamped by ossified cartilages to a complicated sternum. The fore-foot is penta-dactyle; the hind-foot, tetra-dactyle. The lumbar vertebræ are anchylosed to each other and to the sacrum; and the tibia to the fibula. There are seven vertebræ in the sacrum, and twenty in the tail. The Mylodon was a vegetable feeder, and from the conformation of its fore-feet and arms, as well as that of its hind extremities and strong thick tail, it is supposed that it sat in an upright position, stripping the trees of their leaves and tender branches.

LITTLE ANT-EATER.

(*Myrmecophaga didactyla.*)

This Edentate is found only in the forests of Guayana and Brazil. It is about 20 inches long; and the body is covered with soft, curled, silky fur. The general color is a delicate golden straw, with a brownish mark on the back, often wanting. The head is short and tapering; ears close; eyes and mouth small; tongue long and vermiform. It has no teeth. On each fore-foot are two sharp claws, shaped like a hook, and laterally compressed. When folded down they lie upon a callous pad which lines the palm. The hind feet have an oblique position, and are armed with four short, compressed claws. The tail has a strong prehensile power, and is covered with fur, excepting three inches of the under surface at the extremity. The animal has clavicles, and the ribs, which are greatly flattened, overlap each other, so that, on a side view of the skeleton, they appear to be formed of one solid piece of bone. It has many squirrel-like movements, using its fore-claws with great dexterity, and hooking the smaller insects out of the bark-crevices in which they have taken unavailing refuge. In defending itself, the animal strikes with both the fore-paws at once, and with considerable force. It is nocturnal, sleeping during the day with its tail securely twisted around its perch. The female is said to breed in the hollows of trees, producing only one young at a birth, which for some months rides about upon the back of its parent, holding on by coiling its tail around hers, as do some marsupials.

GREAT ANT-EATER.

(*Myrmecophaga jubata.*)

This Ant-eater, the Tamanoir of Buffon, is a native of Guayana, Brazil, Peru, and Paraguay. It is the largest of all toothless terrestrial animals. It measures four feet and a half from the snout to the tail, which is three feet long. The height at the shoulders is three feet and three inches, and two feet and ten inches at the croup; in consequence of which, being perfectly plantigrade, it stands lower behind than before, like the badger and bear. The hair of the head is short and close; but over all the rest of the animal it is long and shaggy, particularly on the top of the neck and on the tail, where it is a foot in length, forming a heavy plume. The color is brown, mingled with gray on the head and face, and interspersed with pure white hairs on the head, body and tail. The throat and hind-legs are black; and a long triangular black band stretches obliquely over the shoulders. The head is wonderfully elongated, tapering and carved; the mouth is a short slit at the extremity of the snout; the eyes are small; the ears are short and round; and the tongue is long, cylindrical, and protractile. The claws of the fore-foot are four in number; of the hind-feet, five. The former, when the animal is walking, are doubled inwards on a rough callous pad, the outer edge of the foot alone touching the ground. The hook-like claws are well adapted for forcibly entering the solid dwellings of the Termite ants. The creature runs with a peculiar trot, and, when chased, will keep a horse in canter. Though not a fighter, it is a match for the Dog, or even the Jaguar,—striking with force, and clasping with a terrible gripe. From its mode of defence it is sometimes called Ant-bear. It does not burrow, contenting itself with the shade of its huge tail when taking its rest. The flesh, though black and musky, is highly esteemed by the Indians.

LONG-TAILED MANIS.

(*Manis longicaudatus.*)

The American Ant-eaters are represented in India and Africa by the Pangolins, or Scaly Ant-eaters, which constitute the strange genus, Manis. The Long-tailed Manis inhabits Western Africa, and attains a large size, measuring two feet in the length of the body, and three feet in the length of the tail. They are covered with an armor of triangular, imbricated, long scales, overlapping each other like the tiles upon the roof of a house,—the natural pattern of the metal bucklers prevalent in the days of chivalry. This defence is not, however, entirely of a passive character, like the shell of the tortoise, but can be converted at will into a powerful weapon of offence. When pursued and unable to escape, the Manis rolls itself up into a ball like a hedge-hog (whence its Malay name of *Pangolin*), wraps the tail over the head, and raises all the sharp-pointed scales in serried array. The head is small and conical ; mouth small ; tongue long and extensible ; eyes minute ; external ears wanting. The limbs are short and thick, and are armed with five claws on each foot,—the three central ones on each foot being of enormous size and arched. Its mode of progression, its food, and its manner of obtaining it, are the same as in the Ant-eater. The last joints of the toes are bifurcated at the extremity,—a peculiarity found in no other Edentate. The tail contains forty-seven vertebræ. The animal dwells in holes which it burrows in the ground.

GLYPTODON.

(*Glyptodon clavicaudatus.*)

This gigantic fossil Edentate was a representative in pleistocene times of the Armadillos of South America. It was furnished with a huge carapace or coat of mail, formed of polygonal long plates, united by sutures, and constituting an impenetrable covering for the upper part of the body and part of the tail. The carapace differs from that of modern Armadillos in having no greaves or joints for the purpose of contracting or rolling up its body. The tail was enclosed in an independent cuirass, like a sword in its scabbard. The head also was defended by a tesselated bony casque. The bones of the leg and foot were perfectly adapted to bear the steady pressure of this enormous weight. The latter is admirably contrived to form the base of a column, and at the same time to allow a degree of motion required for the scratching and digging operations of Dasypoid animals. It is penta-dactylous, four of the digits being furnished with long flattened nails similar to those of the Elephant. The teeth, numbering eight on each side of each jaw, are sculptured laterally by two wide and deep channels, which divide the grinding surface into three portions. The genuine name (Glyptodon, *sculptured tooth*) was derived from this fluting of the molars. The lower jaw is of singular shape,—its angle being elevated to a level with the grinding surface of the teeth. The animal measures from snout to tail, following the curve of the back, nine feet; the tesselated trunk-armor being five feet in length and seven feet across. It can only be matched among shield-bearing animals by the *Schistopleurum typus*, an allied fossil from Montevideo, and by the great land Tortoise whose remains are found fossil in the Siwalik Hills of India.

MEGALONYX.

(*Megalonyx Jeffersonii.*)

This huge terrestrial Sloth, so called for the great size of its claw, is found chiefly in the upper tertiary of America. The genus was established by the philosophic President of the United States, Thomas Jefferson, in a communication read to the American Philosophical Society, March 10, 1797, entitled "*A Memoir on the Discovery of certain Bones of a Quadruped of the clawed kind in the Western Parts of Virginia.*" Other remains have been found in Tennessee, Kentucky, Mississippi and in Alabama. It resembled the Megatherium in general form and habits, but was a third smaller. It is remarkable for the singular expansion of its heel-bone, which gives it the appearance of an ilium of some smaller animal. The upper outline of the skull is nearly horizontal. The zygomatic process has a greater vertical diameter than in the Mylodon; and the temporal fossæ are separated by a saggital crest, instead of a wide, intervening surface. The occipital foramen is sixteen lines in diameter; and the orifice of the nose, a little more than three inches across. The end of the face is relatively narrower and higher than in the Mylodon. The length of the skull is fourteen inches. The dental tormula is M. $\frac{4}{4}$ $\frac{6}{6}$ 18,—the first molars being separated from the rest two inches. As in all the Sloth tribe, they are long fangless columns, deeply excavated from the bottom for the pertsistent pulp, and composed of dentine and cement. The transverse diameter of the larges molar is one inch. The spinal canal, through the atlas and axis is obcordiform, through the remaining cervical vertebræ and anterior dorsals it is trilateral, through the posterior dorsals it is nearly circular, and through the sacrum it is crescentic. Its greatest diameter is over three inches. The clavicles are compressed, cylindroid bones, with a single curvature, and two broad surfaces. The length is eight and three-fourths inches. The humerus is twenty inches long—being relatively much shorter than in the recent Sloths, but both absolutely and relatively longer than that of the Mylodon. The internal condyloid process of the humerus is pierced with a large, oval canal—a peculiarity in its anatomy which it does not share with any other bradypoid animal.

MEGATHERIUM CUVIERI

UNIVERSITY OF ROCHESTER